ORIGINAL ARTICLE

Effects of undercover police stings of gun dealers on the supply of new guns to criminals

D W Webster, M T Bulzacchelli, A M Zeoli, J S Vernick

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See end of article for authors' affiliations

Correspondence to: Daniel W Webster, Center for Gun Policy and Research, Johns Hopkins Bloomberg School of Pubic Health, 624 N Broadway, Room 593, Baltimore, MD 21205-1996, USA; dwebster@jhsph.edu

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Objective: To assess the effects of undercover police stings and lawsuits against gun dealers suspected of facilitating illegal gun sales in three US cities (Chicago, Detroit, Gary) on the flow of new firearms to criminals.

Methods: An interrupted time series design and negative binomial regression analyses were used to test for temporal change in the recovery of guns used in crimes within one year of retail sale in both intervention and comparison cities.

Results: The stings were associated with an abrupt 46.4% reduction in the flow of new guns to criminals in Chicago (95% confidence interval, −58.6% to −30.5%), and with a gradual reduction in new crime guns recovered in Detroit. There was no significant change associated with the stings in Gary, and no change in comparison cities that was coincident with the stings in Chicago and Detroit.

Conclusions: The announcement of police stings and lawsuits against suspect gun dealers appeared to have reduced the supply of new guns to criminals in Chicago significantly, and may have contributed to beneficial effects in Detroit. Given the important role that gun stores play in supplying guns to criminals in the US, further efforts of this type are warranted and should be evaluated.

The homicide rate in the USA is many times higher than that of other high income countries, because of the high rate of homicides with firearms in America.[1] Many armed criminals are legally proscribed from possessing firearms[2] yet are able to obtain them through an illicit market.[3]

A study of illegal firearm trafficking cases investigated by the US Bureau of Alcohol, Tobacco and Firearms (ATF) found that illegal sales by licensed gun dealers account for more guns diverted into the illegal market than any other trafficking channel.[4] A national phone survey of retail gun dealers found that half the dealers expressed a willingness to make a sale under circumstances of questionable legality.[5] A very small proportion of gun dealers sell the majority of guns subsequently used in crime,[6] and the disproportionate connection to crime guns by relatively few retail outlets cannot be explained solely by high sales volumes or by the demographic characteristics or crime rates of the communities where gun stores are located.[7]

This evidence suggests that interventions that increase the risk of penalties, including license revocation, could deter gun dealers from practices that divert guns to criminals. One such strategy is for police to conduct undercover stings designed to catch gun dealers making illegal sales, followed by publicity announcing crackdowns. New York City recently did this with stings of gun dealers in several states followed by lawsuits and possible indictments.[8] This approach has been successful in discouraging stores from selling alcoholic beverages or tobacco to underage youth.[9–13] However, there are no published studies of the effects of stings of gun dealers in order to deter illegal firearms sales. The objective of this study is to estimate the effects of undercover police stings in several cities of licensed gun dealers that were suspected of illegally selling large quantities of guns.

METHODS

Intervention

In 1998 and 1999, law enforcement agencies in metropolitan Chicago (Illinois), Detroit (Michigan), and Gary (Indiana) conducted undercover stings of retail gun stores suspected of facilitating illegal firearm sales. In many of these stings, police officers posed as drug dealers or gang members, often talking with sales clerks about their plans to settle scores with rivals. In some instances, female officers acted as girlfriends of male officers posing as gang members, and purchased firearms clearly intended and paid for by the ''gang member.'' Evidence gathered from these stings was used in lawsuits filed by local governments against gun stores implicated in the stings and others in the gun industry. The lawsuits in Chicago and Detroit garnered significant news coverage and featured videotaped evidence from the stings showing gun store clerks facilitating blatantly illegal sales.

The undercover operations in Chicago were conducted from August through November 1998 and focused on 12 gun dealers in suburban communities in the Chicago metropolitan area. The city of Chicago filed a lawsuit on 12 November 1998 in which the defendants included 12 gun dealers that had facilitated illegal sales. Evidence was also turned over to federal and state prosecutors, and five people were indicted and two convicted.

In the Detroit area, the Wayne County Sheriff's Office conducted 15 undercover stings of 12 gun dealers during March and April 1999. On 26 April 1999, Wayne County filed a lawsuit against the offending gun dealers.

The stings in the Gary area focused on six Northern Indiana gun dealers that sold many guns used in crime in Gary. The undercover operations were conducted by the Gary Police Department in June and July 1999 before the city's lawsuit was filed on 27 August 1999.

Evaluation design

We used an interrupted time series design with no-treatment comparison time series.[14] Three comparison cities (St Louis, Cleveland, and Cincinnati) were identified to determine whether any changes in trends in our outcome measures

Abbreviations: ATF, Bureau of Alcohol, Tobacco and Firearms; IRR, incident rate ratio.

Table 1 Crime guns recovered during study period

City		Sale-to-crime interval <365 d, possessor = retail purchaser	Other guns with sale-to-crime interval <365 d	Sale-to-crime interval 1–3 y	All other crime guns	City total
Chicago, IL	n	66	3084	5394	56856	65 400
	%	0.1%	4.7%	8.2%	86.9%	100%
Detroit, MI	n	84	573	1419	19850	21 926
	%	0.4%	2.6%	6.5%	90.5%	100%
Gary, IN	n	112	530	774	3149	4565
	%	2.5%	11.6%	17.0%	69.0%	100%
Cincinnati, OH	n	92	198	374	4214	4878
	%	1.9%	4.1%	7.7%	86.4%	100%
Cleveland, OH	n	129	243	609	6850	7831
	%	1.6%	3.1%	7.8%	87.5%	100%
St Louis, MO	n	77	238	707	13283	14 305
	%	0.5%	1.7%	4.9%	92.9%	100%
Total	n	589	4945	9428	105587	120 549
	%	0.5%	4.1%	7.8%	87.6%	100.0%

associated with the gun dealer stings in the three intervention cities were also evident in other cities in the Midwestern United States. These comparison cities were selected because they were in the same geographic region as the intervention cities, and each had a policy of tracing all guns recovered from criminals. Like the intervention cities, all three comparison cities filed lawsuits against the gun industry. Unlike the intervention cities, gun dealers were not named as defendants in these lawsuits nor were undercover stings of gun dealers conducted to produce evidence for these lawsuits. In an attempt to identify other interventions that might confound our estimates of the effects of the stings, we used LexisNexis to search for news stories about law enforcement actions against gun stores for illegal sales in the study cities during 1 January 1996 through 31 December 2002.

Data and measures

Outcome data for the study are the results of traces by the ATF of guns recovered in criminal investigations (hereafter referred to as crime guns). We used these data for crime guns recovered between 1 July 1996 and 31 December 2002 in the six study cities. Each of these cities participated in the Youth Crime Gun Interdiction Initiative, a federal initiative in which cities agree to submit information necessary for tracing to ATF for all crime guns from adults as well as juveniles.[15] The number of trace requests fell dramatically in the last half of 2002 in Gary, suggesting a lapse in comprehensive gun tracing practices in that city. Therefore, we omitted the last six months of data for Gary from the analyses. For the same reason, we omitted the first eight months of data for St Louis and Cincinnati.

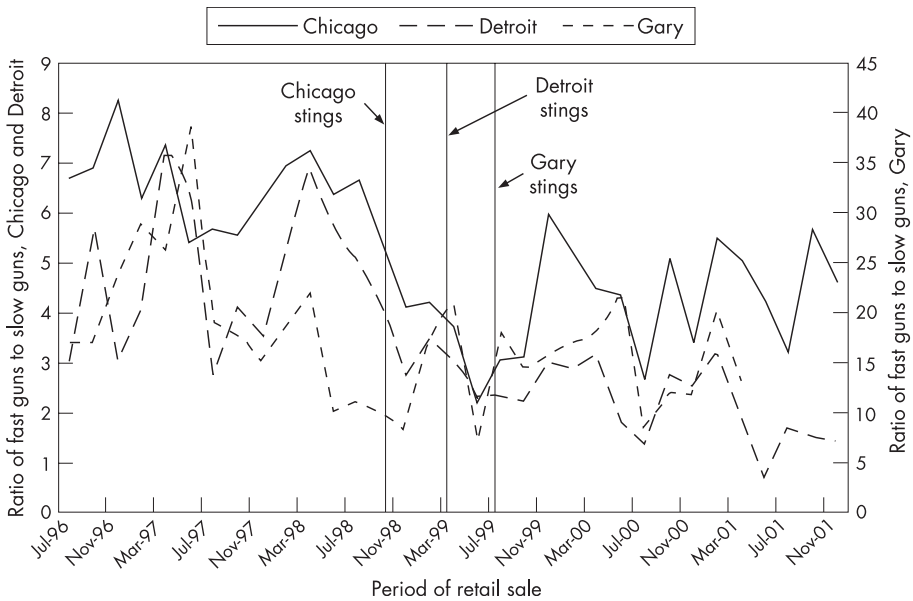

Figure 1 Trends in an indicator of the flow of new guns to criminals (ratio of crime guns recovered within a year of retail purchase by someone other than criminal gun possessor to older guns recovered in crimes times 100) in three cities announcing gun dealer stings and lawsuits by bimonthly sales period.

Using information on the make, model, caliber, and serial number of a firearm, most crime guns can be traced to the original retail sale.[16] A short interval (for example, less than three years) between a gun's retail sale and its subsequent involvement in crime involving a gun possessor who was not the original retail purchaser is considered an indicator of illicit gun trafficking.[16]

Because we were interested in whether the stings influenced retail sales practices that enable guns to be diverted to criminals, we used a more restrictive indicator of the diversion of new guns into the illicit market as our outcome variable–a retail sale-to-crime interval of less than 365 days unless the criminal possessor was also the legal retail purchaser. Our outcome variable, Y_t, was the number of crime guns meeting this definition that were originally sold during a given two month period.

The primary explanatory variable of interest is whether authorities had announced, during or prior to a time period (t), that they had conducted undercover stings of gun stores. This variable was set to equal 1 if stings had been announced before or less than halfway through the period, and set to equal 0 otherwise.

The number of crime guns with short sale-to-crime intervals recovered in a given place and time period can depend upon the degree to which police focus on arresting individuals likely to be in possession of firearms. Thus we controlled for the number of crime guns recovered during a period that were unlikely to have been diverted to the illicit market because of gun store practices. We will refer to such guns as ''older guns.'' A gun was designated as older if it had a retail sale-to-crime interval of three years or more, if it was designated as ''too old to trace'', or if it had been sold by a gun dealer who was out of business by the time the gun was recovered from a criminal. The explanatory variable used in the analyses was the number of older guns recovered within the same 365 day period following each two month sale period for our trafficking outcome variable. To control for possible changes in criminals' demand for guns, we included violent crime rates reported by local police as covariates in the analyses. Data on violent crime were obtained from the FBI's Uniform Crime Reporting Program (UCR).

The study protocol was approved by the committee for human research of the Johns Hopkins Bloomberg School of Public Health.

Analyses

The primary analyses tested whether there was a change in the outcome variable following the announcement of gun dealer stings in each of the intervention cities, and whether there were any such changes in comparison cities. Because the outcome variable represented counts, we estimated the effect of the stings using negative binomial regression models where the number of newer crime guns sold by a retailer in a period was assumed to be a function of the stings, the number of older crime guns being recovered, the rate of violent crime, and a linear trend term when a preintervention trend was evident. Sting effect coefficients were converted to incident rate ratios (IRR), thus allowing for easy estimates of the percentage change in the outcome measure.

Because the outcome variable was normally distributed in each of the cities except for St Louis, we also estimated the stings' effects using least squares regression, thus enabling us to calculate Durbin–Watson statistics[17 18] to test for serially correlated model errors. We also tested for influential observations that could skew model estimates using Cook's distance and centered leverage values.[19] In addition, we examined the autocorrelation function and partial autocorrelation function of the residuals to identify any patterns of serial correlation.

RESULTS

Descriptive information on crime guns in study

In all, 120 549 crime guns were included in the analyses and were assigned to one of four categories. Four percent (4945) met our definition for a new crime gun likely to be trafficked—sale-to-crime interval of less than 365 days unless the criminal possessor was the retail purchaser of record. Eight percent (9428) had a sale-to-crime interval of between one and three years, and 88% were older guns. Cities varied in the percentage of crime guns that were new and potentially trafficked, ranging from 1.7% in St Louis to 11.6% in Gary (table 1).

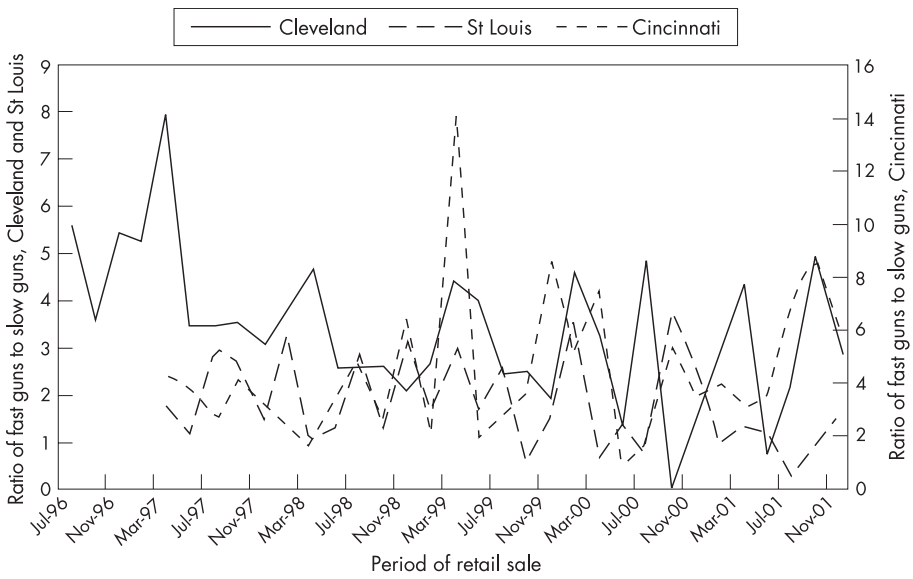

Figure 2 Trends in an indicator of the flow of new guns to criminals (ratio of crime guns recovered within a year of retail purchase by someone other than criminal gun possessor to older guns recovered in crimes ×100) in three Midwest cities that did not conduct gun dealer stings or sue gun dealers, by bimonthly sales period.

Table 2 Estimates from negative binomial regressions on the number of crime guns recovered within a year of retail sale from someone other than the retail purchaser

City and explanatory variable	IRR (% change)	95% CI for IRR		LR χ^2 (df), p value
		LL	UL	
Chicago, IL				55.4 (3), <0.001
Stings announced	0.536*** (−46.4)	0.414	0.695	
Slower guns recovered	1.000**	1.000	1.000	
Violent crime rate	0.998**	0.996	0.999	
Detroit, MI				8.12 (3), 0.044
Stings announced	0.714 (−28.6)	0.465	1.098	
Slower guns recovered	1.000*	1.000	1.000	
Violent crime rate	0.999	0.997	1.001	
Gary, IN				14.42 (4), 0.006
Stings announced	1.515 (+51.5)	0.909	2.527	
Slower guns recovered	1.002	0.998	1.006	
Violent crime rate	0.999	0.998	1.001	
Linear trend	0.953	0.926	0.982	
Cincinnati, OH				
Chicago stings	1.391 (+39.1)	0.954	2.029	12.92 (2), 0.002
Detroit stings	1.956 (+95.6)	0.433	8.856	11.06 (3), 0.001
Gary stings	1.837 (+83.7)	0.615	5.480	11.50 (3), 0.009
Cleveland, OH				
Chicago stings	1.003 (+0.3)	0.512	1.965	22.77 (4), <0.001
Detroit stings	1.143 (+14.3)	0.590	2.212	22.93 (4), <0.001
Gary stings	0.967 (−3.3)	0.504	1.855	22.78 (4), <0.001
St Louis, MO				
Chicago stings	0.926 (−7.4)	0.476	1.803	2.06 (3), 0.559
Detroit stings	0.736 (−26.4)	0.462	1.173	3.64 (3), 0.303
Gary stings	0.748 (−25.2)	0.489	5.480	5.11 (3), 0.164

***p<0.001, **p<0.01, *p<0.05
CI, confidence interval; df, degrees of freedom; IRR, incident rate ratio; LR, likelihood ratio.

Trends

Trends in the ratio of new crime guns to older crime guns are presented in fig 1 (intervention cities) and fig 2 (comparison cities). Before the announcement of stings in the Chicago area, the recovery of new crime guns fluctuated greatly in Chicago and Gary, and was drifting downward in Gary. Recoveries of new crime guns in Chicago fell sharply for guns sold in late 1998 and continued to decline, before rebounding somewhat for sales dates after October 1999. In Detroit, the indicator of the flow of new guns to criminals dropped during November–December 1998 (the period in which Chicago announced its stings and lawsuit), drifted upward during the first four months of 1999, and started a downward trend in May–June 1999, following the announcement of Detroit's stings and lawsuit. There was no obvious change in the number of new crime guns traced in Gary coincident with the announcements of the gun dealer stings in Chicago or in Gary (27 August 1999).

Figure 2 reveals no trends for Cincinnati or St Louis and a slight decline in Cleveland before the announcement of the first stings in November–December 1998. There is no visual evidence of change in our indicator of the flow of new guns to criminals in the comparison cities that is coincident with the timing of the stings announcements in the intervention cities.

Model estimates

Estimates of the effects of the stings varied between the three intervention cities (table 2). The stings in the Chicago area were associated with a 46% decline in the flow of new guns into the illicit market during the 38 month follow up period ($p<0.001$). The estimated effect of the stings on new crime guns sold by in-state retailers was a 61.8% ($p<0.001$; IRR = 0.382 (95% confidence interval (CI), 0.278 to 0.526)).

In Detroit, there was an estimated 28.6% decline in the mean number of new crime guns recovered associated with Detroit's stings, but the effect was not statistically significant ($p = 0.126$). The estimate of Detroit's stings effects from the linear model was similar, but approached statistical significance (−26%, $p = 0.063$). If the intervention's effects are modeled as a gradual change in the number of new guns recovered from Detroit criminals, the stings were associated with a reduction in new crime guns of 2.1% every two months throughout the 34 month retail sales period following the stings (IRR = 0.979 (95% CI for IRR = 0.964 to 0.994), $p = 0.006$). The gradual change model fitted the data better than the model that assumed an abrupt intervention effect (likelihood ratio (LR) $\chi^2 = 12.88$ (3), $p = 0.006$, for the gradual change model *v* LR $\chi^2 = 8.12$ (3), $p = 0.044$, for the abrupt change model). When the analyses were restricted to new crime guns sold by in-state retailers, the abrupt change model estimated a 35.9% reduction associated with the Detroit area stings (IRR = 0.641 (95% CI, 0.411 to 1.001), $p = 0.051$), and the gradual change model estimated a 2% reduction every two months following the stings (IRR = 0.980 (95% CI, 0.964 to 0.998), $p = 0.026$).

The model estimates a 51% increase in the recovery of new guns from criminals in Gary following the announcements of the stings; however, the effect was not statistically significant ($p = 0.111$). When the analyses were restricted to new crime guns sold by in-state retailers, the estimate of the stings effect was still positive and not statistically significant (IRR = 1.638 (95% CI, 0.974 to 2.753), $p = 0.063$). The Durbin–Watson statistic from the linear model was in the range of possible serial correlation; however, the autocorrelation functions for the model residuals revealed no statistically significant spikes.

Data from each of the three comparison cities were used to identify any significant changes in the flow of new guns to

criminals coincident with the stings in Chicago, Detroit, and Gary. None of the models revealed changes associated with the timing of the stings that approached statistical significance (table 2).

DISCUSSION

The findings from this study provide mixed evidence for the effectiveness of undercover police stings of gun dealers in reducing the flow of new guns to criminals. The stings appeared to be most successful in Chicago, where they were associated with a 61.8% reduction in new crime guns sold by in-state retailers, and an overall 46.4% reduction in the supply of new guns to criminals. This reduction was abrupt, coincident with the timing of the announcement of the stings, and most pronounced during the first 12 months following the intervention.

The effects of the stings in Detroit are less clear. Models that assumed an abrupt and constant effect of the stings estimated a 35.9% reduction in new crime guns that had been sold by in-state retailers, and a non-significant 28.6% decline in all new crime guns. However, the estimate of the sting effects in Detroit varied depending on the functional form of the model chosen, and the assumption about the timing of the effects. The estimate of the sting effects from a linear model was similar in magnitude to those from the negative binomial models, but was significant at the 0.1% level. All models that assumed a gradual effect over the post-sting period fitted the data better and produced statistically significant estimates of the stings effects. However, an abrupt change is more consistent with our hypothesis that the announcement of the stings and the lawsuit against the gun dealers would have an immediate chilling effect on retail sales practices that divert firearms to criminals. There was no apparent effect of the stings in Gary.

Why did three apparently similar interventions produce different outcomes? The immediate and dramatic effect observed in Chicago could be because its stings and lawsuit receiving greater publicity than in the other cities, perhaps as it was the first to undertake these actions. Chicago was also the only one of the three cities where the evidence collected from the stings was used in criminal indictments against gun store owners and employees. The idea that sufficient threat of criminal sanctions could be key to the effectiveness of stings of gun stores is consistent with the theory of criminal deterrence.[20] Law enforcement practices may also explain why the flow of new guns to criminals in Detroit continued to decrease many months after the stings were announced. The ATF agent overseeing gun law enforcement in the Detroit area during the post-sting period indicated that ATF gave considerable attention to suspect gun stores during 2000 through 2002 (Chipman D, Chief of Firearms Enforcement for the Bureau of Alcohol, Tobacco, Firearms and Explosives on 27 April 2005, personal communication). These efforts may have confounded our estimate of the independent effects of the Detroit area stings in 1999. Comprehensive anti-gun-trafficking law enforcement can reduce the flow of new guns to criminals.[21] The least promising results were for Gary, where fewer stings were done, there was little news coverage, and no evidence of law enforcement follow up.

Some are skeptical of the ability of any supply-side firearm strategy to influence violence in the USA, given the relatively large supply of guns in civilian hands.[22] However, there is preliminary evidence that indicators of gun trafficking based on crime gun traces are positively associated with robberies involving guns after controlling for potential confounding variables.[23]

There are several limitations to our study. The outcome measure used is an indicator rather than the actual number of new guns supplied to the illicit market, because many criminals do not have their gun confiscated by police within a year of the retail sale. Nevertheless, after controlling for the number of older crime guns recovered during a given period, our outcome measure should be a reliable indicator for tracking proportional changes in the flow of new guns to criminals in a city.

The study does not explicitly control for other law enforcement interventions put into place during the study period which might affect criminals' acquisition of new guns through retail purchasers. However, there was no evidence of significant anti-trafficking initiatives during the study period, except for the indictments following Chicago's stings.

The generalisability of the findings of this study is unknown. There is considerable regional variation in gun ownership,[24] regulation of firearm sales,[25] and illicit gun markets.[15 26] In addition, most other industrialized countries regulate firearms more restrictively than the USA. Illegally trafficked US firearms, therefore, are an important source of crime guns in other nations as well.[27]

One factor potentially relevant to the generalisability of our findings about undercover stings of gun dealers is that the stings were coupled with lawsuits against suspected gun dealers in each of the three intervention cities. These lawsuits may have played a significant role in reducing sales practices conducive to straw purchases made on behalf of proscribed purchasers. Legislation was recently enacted that provides the gun industry with very broad immunity from lawsuits.[28] Therefore, future gun dealer sting operations may not have the potential threat of a lawsuit as an added deterrent to illicit gun sales practices. However, undercover stings of retail sellers of alcohol and tobacco for illegal sales to minors have reduced illegal sales practices without the added deterrent of lawsuits.[9–13] Furthermore, the stings examined in this study were conducted with no coordination with the ATF or federal prosecutors and, with the exception of Chicago, little follow through with prosecutions. Increased use of undercover stings in conjunction with aggressive prosecution and stiff penalties for gun sales law violations could reduce illegal straw sales that provide firearms to criminals.

Implications for prevention

Many firearms used in homicides and non-fatal shootings are obtained through an illicit market supplied by guns sold by licensed dealers. Use of undercover stings of gun dealers, when coupled with criminal prosecutions and publicity, is a promising strategy for deterring retail sales practices that facilitate the diversion of firearms to criminals. Further research is needed to determine whether deterring illegal or

Key findings

- The announcement of undercover police stings and lawsuit against gun dealers in metropolitan Chicago, Illinois (USA) was associated with a 46.4% decline in the flow of new guns to criminals.
- A similar intervention in the Detroit, MI (USA) area was associated with a less dramatic decline in the flow of new guns to criminals in Detroit; however, the decline was gradual over a 32 month post-intervention period.
- A less intensive intervention involving stings of gun dealers near Gary, IN (USA) was not associated with any significant change in new guns to criminals.
- No significant temporal change in new crime guns was evident in three comparison cities from the same region.

careless retail sales practices will lead to reductions in gun violence.

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Authors' affiliations

D W Webster, M T Bulzacchelli, A M Zeoli, J S Vernick, Center for Gun Policy and Research, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA

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